APPENDIX

IN THE UNITED STATES COURT OF APPEALS

For The Fifth Circuit

No. 71-2650

KARL ZIEGLER,

Plaintiff-Appellant-Cross Appellee,

versus

PHILLIPS PETROLEUM COMPANY,

Defendant-Appellee-Cross Appellant.

Appeal from the United States District Court for the Northern District of Texas

Before BELL and RONEY, Circuit Judges, and BREWSTER*, District Judge

BY THE COURT:

IT IS ORDERED that Appellee's motion to add U. S. Patent No. 3,582,987 to the record for consideration on petition for rehearing, and supporting affidavit and memorandum, filed in the above styled and numbered cause is hereby granted.

IT IS FURTHER ORDERED that Appellee's petition for rehearing filed in the above cause is hereby denied.

Dated August 3, 1973

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* Hon. Leo Brewster, Chief Judge, United States District Court of the Northern District of Texas, sitting by designation.

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Appeals from the United States District Court for the Northern District of Texas

(April 13, 1973)

Before BELL and RONEY, Circuit Judges and BREWSTER, District Judge.

RONEY, Circuit Judge: This patent infringement suit involves two patents claiming chemical catalysts. We affirm the District Court's finding of non-infringement as to one patent, but reverse as to the other.

Catalysts are chemical substances that affect the rate or course of a given chemical reaction in some manner without becoming a significant part of the resulting product. In this case, both catalysts find wide application in the petrochemical field and are used to cause small molecules of gases or liquids to react together to form solid plastics and synthetic rubbers from which commercially useful articles and objects may be fabricated for use in everyday living.

The nature of these patents and the processes involved in their application pose especially difficult decisions for non-chemist judges. Although patent cases often present complex and technical questions, suits involving chemical patents present a complexity of a higher order. Unlike mechanical patents, the workings of which may at least be visualized and conceptualized by the lay mind, chemical patents take us into a realm of symbolic analysis. The

reactions occurring in these processes cannot be appreciated by the independent senses: they cannot be seen, felt, or heard. Hence, chemists must describe them in terms of symbols, including letters and numbers.

Because the scientific underpinnings of chemical patents are so complex, trial courts must depend heavily upon expert witnesses for both explanation and evaluation of the patent disclosures and the accused infringing operations. Similarly, appellate courts must rely heavily upon the findings and credibility choices made by trial courts. Otherwise, we would be thrust into the position of reconsidering credibility and re-resolving conflicts in expert testimony, a position that mistakes this Court's function. *American Seating Co.* v. *Southeastern Metals Co.*, 412 F.2d 756 (5th Cir. 1969); compare Rule 52(a), F.R.Civ.P. Nonetheless, our review of the District Court's findings is not limited to an examination of the expert testimony. Appellant raises a serious legal contention about the proper construction of a patent on a chemical catalyst, posing questions of law that go beyond the scope of expert testimony and this contention must be resolved before we can turn to the construction of the specific patents in suit.

I. Background

Before submerging ourselves in an examination of the various contentions put forth by the parties, a brief review of the relevant principles of organic chemistry will be helpful. Both patents here in suit are directed to polymerization catalysts used in the chemical reaction processes that produce synthetic polymers.

A catalyst is defined as a substance which affects the rate or course of a given chemical reaction in some manner without becoming a significant part of the reaction product. Normally, catalysts are used in relatively small amounts as compared with the reactants.

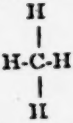
Synthetic polymers are produced by causing hydrocarbon molecules, called monomers, which are generally

in liquid or gaseous form, to link together in long chains. These long chains are called polymers. The linking of the monomers is termed a polymerization reaction, and the polymerization catalyst is what causes the monomers to link together to form polymers.

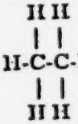
Ethylene, propylene, and butadiene, related gases generally obtained from the petroleum industry, are the monomers involved in this suit. These monomers have at least one double bond between two carbon atoms in their small chains, called an olefinic bond, and are known as olefins. Ethylene has two carbon atoms, propylene three, and butadiene four.[1] When these monomers are

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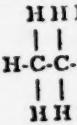
[1]The most basic organic chemicals, formed solely from the elements carbon and hydrogen, are referred to as hydrocarbons. Methane, the smallest hydrocarbon molecule, consists of one carbon atom joined with four atoms of hydrogen. The chemist's formula for methane is CH_4 and is diagrammed:



Ethane, the next lowest hydrocarbon molecule, consists of two carbon atoms joined with six hydrogen atoms. Ethane is formulated as $CH_3 - CH_3$ and is diagrammed:



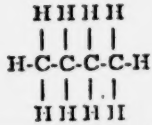
Three carbon atoms may join together with eight hydrogen atoms to form the hydrocarbon propane. Propane is formulated as $CH_3 - CH_2 - CH_3$ and is diagrammed:



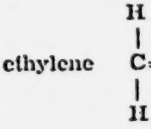
Similarly, four carbon atoms may join together with ten hydrogen atoms to form the hydrocarbon butane, formulated as $CH_3 - CH_2 - CH_2 - CH_3$ and diagrammed:

polymerized, they yield the synthetic polymers of primary concern in this suit, polyethylene, polypropylene, and polybutadiene, the solid material of commercially useful plastic and synthetic rubbers. Prior to the invention of the catalysts covered by the patents in suit, the polymerization of these olefins was difficult. Harsh reaction

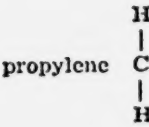
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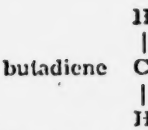
Instead of joining together with the single bond illustrated above, it is also possible for carbon atoms to join one another with a double connecting bond. Among these hydrocarbons are:



ethylene, also written $CH_2=CH_2$;



propylene, also written $CH_2=CH-CH_3$; and



butadiene, also written $CH_2=CH-CH=CH_2$.

The double bond (=) connecting the adjacent carbon atoms is referred to by chemists synonomously as an olefinic bond or an unsaturated bond. Where this bond occurs between the first and second carbon atoms of the hydrocarbon chain, the hydrocarbon is called an alpha olefin. The characteristic $CH_2=CH-$ group of these alpha olefins is also synonomously referred to as the ethylenically unsaturated group or vinyl group. Ethylene, propylene, and butadiene are all olefins. More specifically, they are all ethylenically unsaturated olefins.

conditions of extremely high pressure and elevated temperatures were required, and the olefins combined in disorderly arrays with many branched sidechains. "Unlike these inferior polymers, though, the polymers formed with Ziegler's catalysts have a higher density, greater rigidity and strength, and higher flow and melt temperatures."

The chemical catalyst patents in suit were developed by Karl Ziegler, the plaintiff, a citizen and resident of West Germany. In 1953, Ziegler and three co-workers at the Max-Planck-Institute in Mulheim, West Germany, discovered that several combinations of an organo aluminum compound and a compound of a metal of Groups IV-B, V-B, or VI-B of the Periodic System of Elements, produced polymerization catalysts that polymerized olefins much more effectively than was previously possible. The catalysts caused monomers to combine in a linear fashion, forming straight and not branched chains, without requiring the formation process to include high pressures or excessive temperatures. These various polymerization catalysts were recognized as a great scientific achievement and were named, and are universally known as, "Ziegler catalysts." For this discovery, Ziegler and his co-workers were awarded the Nobel Prize. This suit asks us to define the breadth of two of the many United States patents protecting Ziegler's research.

Ziegler brought this patent infringement suit against Phillips Petroleum Company, charging infringement of United States Letters Patent Nos. 3,113,115 of December 3, 1963, and 3,257,332 of June 21, 1966. Phillips counterclaimed for a declaratory judgment of invalidity with respect to both patents. After a trial requiring twelve days of extensive oral testimony and 140 exhibits, the District Court denied both Ziegler's claim of infringement and Phillips' counterclaim by adjudging the patents valid but not infringed. Both parties appeal from the District Court judgment.

II. The Patents in Suit

Patent No. 3,257,332, (the '332 patent), entitled "Polymerization of Ethylene," was issued June 21, 1966, on an application filed November 15, 1954. The fourteen claims in the '332 patent are set out in the margin.[2]

Although the complaint asserts nine of these claims against the alleged infringing process, it is only necessary to deal with claim Number 1 since it describes in general terms the compounds which are more specifically named in the other claim. An infringement of any of the claims asserted would necessarily infringe claim Number 1.

Claim Number 1 states that the '332 patent is directed toward a

> "[p]olymerization catalyst, comprising the product formed by mixing an effective amount of an aluminum trialkyl with a compound of a metal selected from

[2] *THE '332 PATENT CLAIMS*

"1. Polymerization catalyst comprising the product formed by mixing an effective amount of an aluminum trialkyl with a compound of a metal selected from the group consisting of salts, freshly precipitated oxides and hydroxides of metals of Groups IV-B, V-B and VI-B of the Periodic System, including thorium and uranium.

2. Catalyst according to claim 1, containing an excess of said aluminum trialkyl.

3. Catalyst according to claim 1, formed by mixing 2*n* - 3*n* mols of said aluminum trialkyl with each mol of said metal compound, *n* representing the valence of said group members.

4. Catalyst according to claim 1, in which said metal compound is an acetyl acetonate. [Not in suit here]

5. Catalyst according to claim 4, formed by mixing 2 mols of said aluminum trialkyl per mol of said metal compound.

6. Catalyst according to claim 1, in which said metal compound is a chloride.

7. Catalyst according to claim 1, in which said metal compound is an oxychloride. [Not in suit here]

8. Catalyst according to claim 1, in which said metal compound is titanium tetrachloride.

9. Catalyst according to claim 1, in which said metal compound is zirconium acetyl acetonate. [Not in suit here]

10. Catalyst according to claim 1, in which said metal compound is thorium acetyl acetonate. [Not in suit here]

11. Catalyst according to claim 1, in which said metal compound is uranium tetrachloride. [Not in suit here]

12. Catalyst according to claim 1, in which said aluminum trialkyl is aluminum triethyl.

13. Catalyst according to claim 12, in which said metal compound is a chloride.

[illegible]

the group consisting of salts, freshly precipitated oxides and hydroxides of metals of Groups IV-B, V-B and VI-B of the Periodic System, including thorium and uranium."

In this patent, the organo-aluminum compound part of the catalyst is an aluminum trialkyl.

The other patent, No. 3,113,115, entitled "Polymerization Catalyst," (the '115 patent), was issued December 3, 1963, on an application filed October 29, 1958. It is directed at catalysts in which the organoaluminum compound is *dialkyl* aluminum instead of *trialkyl* aluminum as in the '332 patent. Of the eighteen claims in the '115 patent, nine are in suit, and these claims are set out in the margin.[3]

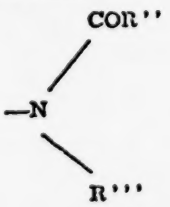
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[3] *THE '115 PATENT CLAIMS*

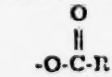
"1. Polymerization catalyst essentially consisting of an aluminum compound having the general formula $RR'AlX$, in which R is a member selected from the group consisting of hydrogen, alkyl radicals and aryl radicals, R' is a member selected from the group consisting of hydrogen, alkyl radicals and aryl radicals, and in which X is a member selected from the group consisting of hydrogen, halogen atoms, alkoxy radicals, aryloxy radicals, secondary amino radicals of the formula



in which R'' and R''' are hydrocarbon radicals, secondary acid amide radicals of the formula



in which R'' and R''' are as given above, mercapto radicals, and radicals of carboxylic acids of the formula



in which R'' is as given above, with a heavy metal compound selected from the group consisting of salts, freshly precipitated oxides and hydroxides of metals of groups IV-B, V-B, and VI-B

III. The Alleged Infringing Phillips Processes

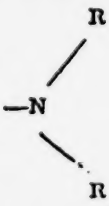
This case was commenced on September 6, 1967, when Ziegler filed suit on the '332 patent. Ziegler charged specifically that the catalyst employed in Phillips' polybutadiene polymerization operation at Borger, Texas, infringed the '332 patent.

On August 12, 1969, Ziegler amended his original complaint to include the '115 patent. Ziegler charged that the catalyst employed in Phillips' polypropylene operation at its Adams Terminal and Monument plants in Texas infringed the '115 patent.

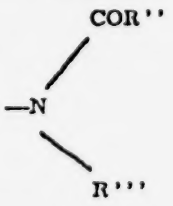
In the polymerization of butadiene at the Borger plant, Phillips mixed and reacted three components, aluminum triethyl, titanium tetrachloride, and iodine, in the presence of butadiene to produce polybutadiene. The evidence

of the periodic system, including thorium and uranium, metals of group VIII of the periodic system and manganese.

2. Polymerization catalyst, essentially consisting of the product formed by mixing an aluminum compound having the general formula RR'AlX, in which R is a member selected from the group consisting of hydrogen and alkyl radicals and aryl radicals, R' is a member selected from the group consisting of hydrogen, alkyl radicals and aryl radicals, and in which X is a member selected from the group consisting of hydrogen, halogen atoms, alkoxy radicals, aryloxy radicals, secondary amino radicals of the formula



in which R'' and R''' are hydrocarbon radicals, secondary acid amide radicals of the formula



in which R'' and R''' are as given above, mercapto radicals, and radicals of carboxylic acids of the formula



showed that a stream of butadiene and toluene and a stream of aluminum triethyl and toluene are first combined and then introduced into a mix pot. Then separate streams of titanium tetrachloride diluted in toluene and free iodine diluted in toluene are introduced into the mix pot. These materials are then mixed together in the mix pot and the mixture is passed into a reactor where the butadiene polymerizes into high *cis*, 1,4-polybutadiene rubber.

In the polymerization of propylene at the Adams Terminal and Monument plants, Phillips mixed and reacted three components, diethyl aluminum chloride, titanium trichloride, and aluminum trichloride, in the presence of propylene to produce polypropylene. The evidence showed that Phillips' operation involved mixing a stream of propylene with diethyl aluminum chloride in a solvent pentane and then introducing this mixture into a loop-type reactor. A complex of titanium trichloride and aluminum trichloride dispersed in pentane solvent is first mixed with propylene and then introduced into the reactor. A solid polymer, polypropylene, is recovered from the reactor.

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in which R' is as given above, with a heavy metal compound selected from the group consisting of salts and the freshly precipitated oxides and hydroxides of metals of groups IV-B, V-B, and VI-B of the periodic system, including thorium and uranium, metals of group VIII of the periodic system and manganese, in an inert organic solvent with at least one of said aluminum compounds and said heavy metal compounds in solution in said solvent.

3. Catalyst according to claim 1, in which said aluminum compound is a dihydrocarbon aluminum halide.

4. Catalyst according to claim 1 in which said aluminum compound is a dialkyl aluminum monohalide and in which said heavy metal compound is a compound of a metal from group IV-B of the periodic system.

9. Catalyst according to claim 1 in which said heavy metal compound is a compound of a metal from group IV-B of the periodic system.

15. Catalyst according to claim 2 in which said aluminum compound is a dihydrocarbon monohalide and in which said heavy metal compound is a heavy metal salt.

16. Catalyst according to claim 15 in which said salt is titanium tetrachloride.

17. Catalyst according to claim 1 in which said aluminum compound is dialkyl aluminum monohalides and in which said heavy metal compound is titanium tetrachloride.

18. A catalyst consisting essentially of a mixture of a

Thus, this case involves two separate and distinct polymerization operations of Phillips', with the catalyst claims of the '332 patent being asserted against a polybutadiene process and the different catalyst claims of the '115 patent being asserted against a polypropylene process. Therefore, after setting out the law governing patent infringement and construction, we consider each patent and the corresponding claim of infringement separately.

IV. Scope of Review

At the outset, we must determine the proper scope of appellate review. The question of infringement of a patent is a question of fact. *Coupe* v. *Royer*, 155 U.S. 565 (1895); *Winans* v. *Denmead*, 56 U.S. (15 How.) 330 (1853); *Marvin Glass & Associates* v. *Sears, Roebuck & Co.*, 448 F.2d 60 (5th Cir. 1971); *U.S. Industries, Inc.* v. *Otis Engineering Corp.*, 254 F.2d 198 (5th Cir. 1958). Hence, the "clearly erroneous" doctrine of Rule 52(a), F.R.Civ.P., is clearly applicable to the District Court's findings on the infringement question. *American Seating Co.* v. *Southeastern Metals Co., supra*; *Phillips Petroleum Co.* v. *Sid Richardson Carbon & Gas Co.*, 416 F.2d 10 (5th Cir. 1969). But infringement ceases to become a pure question of fact, and therefore the force of Rule 52(a) diminishes, when the question of infringement requires the District Court first to construe the patent. The construction of a patent is a matter of law, *Coupe* v. *Royer, supra*; *Cold Metal Process Co.* v. *E. W. Bliss Co.*, 285 F.2d 231 (6th Cir. 1960), *cert. denied*, 366 U.S. 911 (1961); 4 Walker on Patents § 230 (Deller's ed. 1964), and appellate courts are not bound by the strictures of Rule 52(a) when the District Court erred in construing the patent in question. *Harrington Mfg. Co., Inc.* v. *White*, ... F.2d ..... (5th Cir. 1973) [No. 71-2032, Mar. 13, 1973].

V. The Applicable Law of Infringement

Infringement exists only where the accused device and the teachings of the patent in suit are "substantially

showed that a stream of butadiene and toluene and a stream of aluminum triethyl and toluene are first combined and then introduced into a mix pot. Then separate streams of titanium tetrachloride diluted in toluene and free iodine diluted in toluene are introduced into the mix pot. These materials are then mixed together in the mix pot and the mixture is passed into a reactor where the butadiene polymerizes into high *cis*, 1,4-polybutadiene rubber.

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4. Catalyst according to claim 1 in which said aluminum compound is a dialkyl aluminum monohalide and in which said heavy metal compound is a compound of a metal from group IV-B of the periodic system.

9. Catalyst according to claim 1 in which said heavy metal compound is a compound of a metal from group IV-B of the periodic system.

15. Catalyst according to claim 2 in which said aluminum compound is a dihydrocarbon monohalide and in which said heavy metal compound is a heavy metal salt.

16. Catalyst according to claim 15 in which said salt is titanium tetrachloride.

17. Catalyst according to claim 1 in which said aluminum compound is dialkyl aluminum monohalides and in which said heavy metal compound is titanium tetrachloride.

18. A catalyst consisting essentially of a mixture of a dialkyl aluminum halide and titanium tetrachloride.

Thus, this case involves two separate and distinct polymerization operations of Phillips', with the catalyst claims of the '332 patent being asserted against a polybutadiene process and the different catalyst claims of the '115 patent being asserted against a polypropylene process. Therefore, after setting out the law governing patent infringement and construction, we consider each patent and the corresponding claim of infringement separately.

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V. The Applicable Law of Infringement

Infringement exists only where the accused device and the teachings of the patent in suit are "substantially

identical in structure, mode of operation, and results accomplished." *American Seating Co.* v. *Southeastern Metals Co., supra*; *Stewart-Warner Corp.* v. *Lone Star Gas Co.*, 195 F.2d 645 (5th Cir. 1952); *see Hobbs* v. *United States, Atomic Energy Commission*, 451 F.2d 849 (5th Cir. 1971). In applying this general test of infringement, courts follow a two-step analysis. First, does the accused device, process, or composition of matter literally infringe the patent in question? If not, then second, does the "doctrine of equivalents" nevertheless lead to a finding of infringement?

Literal Infringement

When we seek to determine what the patented invention is, we must first turn to the claims of the patent because the scope of every patent is limited to the invention described in its claims, read in the light of the specifications. *Motion Picture Patents Co.* v. *Universal Film Mfg. Co.*, 243 U.S. 502 (1917); *Texsteam Corp.* v. *Blanchard*, 352 F.2d 983 (5th Cir. 1965), *cert. denied*, 387 U.S. 936 (1967). As the Supreme Court stated in *Graver Tank & Mfg. Co., Inc.* v. *Linde Air Products, Inc.*, 339 U.S. 605, 607 (1950): "In determining whether an accused device or composition infringes a valid patent, resort must be had in the first instance to the words of the claim. If accused matter falls clearly within the claim, infringement is made out and that is the end of it." *See Williams Bit & Tool Co.* v. *Christensen Diamond Products Co.*, 399 F.2d 628 (5th Cir. 1968).

Doctrine of Equivalents

If patents were interpreted only by the literal scope of their claims, however, minor deviations in the structure of almost any invention could be devised to elude the reach of the patent's protection. Thus, experience with patent cases demonstrates that seldom may the question of infringement be determined on the literal words of the claim. *U.S. Industries, Inc.* v. *Otis Engineer-*

ing Corp., 277 F.2d 282 (5th Cir. 1960). In recognition of the fact that a patent would be virtually worthless if it did not protect against devices which incorporate unimportant variations of the patented device, courts developed the doctrine of equivalents to protect the patentee from devices that differ merely in name, form, or shape from the patented invention, *Machine Co.* v. *Murphy*, 97 U.S. 120, 125 (1877), but perform substantially the same function in substantially the same way to obtain the same result. *Graver, supra*; *Sanitary Refrigerator Co.* v. *Winters*, 280 U.S. 30 (1929).

To establish equivalency for the purpose of showing infringement of a patent claim, the patentee has the burden of proving a real identity of means, operation, and result. *Foster Cathead Co.* v. *Hasha*, 382 F.2d 761 (5th Cir. 1967), *cert. denied*, 390 U.S. 906 (1968); *Texsteam Corp.* v. *Blanchard, supra*; *Stewart-Warner Corp.* v. *Lone Star Gas Co., supra*. But while substantial identity of function, operation, and result are necessary, the doctrine

> "does not require complete identity for every purpose and in every respect. In determining equivalents, things equal to the same thing may not be equal to each other and, by the same token, things for most purposes different may sometimes be equivalents."

Graver, supra, at 609. Hence, minor variations between the accused structure and the precise language of the claims in question do not prevent a holding of infringement. *Graver, supra*; *Samuelson* v. *Bethlehem Steel Co.*, 323 F.2d 944 (5th Cir. 1963), *cert. denied*, 376 U.S. 938 (1964); *Up-Right Inc.* v. *Safway Products, Inc.*, 315 F.2d 23 (5th Cir.), *cert. denied sub nom. Beatty Safway Scaffold Co.* v. *Up-Right, Inc.*, 372 U.S. 934 (1963).

In its early development, the doctrine of equivalents generally was applied in cases involving the equivalence of devices having mechanical components. Today, however, the same principles are applied to compositions of matter where there is equivalence between chemical

ingredients. *See Graver, supra*; *Chemical Cleaning, Inc.* v. *Dow Chemical Co.*, 379 F.2d 294 (5th Cir. 1967), *cert. denied*, 389 U.S. 1040 (1968). *See also* 4 Walker on Patents, *supra*, § 250. In *Graver* the Supreme Court spoke to the problem of determining what constitutes equivalency.

> "Consideration must be given to the purpose for which an ingredient is used in a patent, the qualities it has when combined with the other ingredients, and the function which it is intended to perform."

Graver, supra, at 609.

A necessary corollary to the general doctrine of equivalents is that patent claims are construed in the light of the description and to cover the real invention found in the specification and drawings. *Kinnear-Weed Corp.* v. *Humble Oil & Refining Co.*, 259 F.2d 398 (5th Cir. 1958), *cert. denied*, 361 U.S. 903 (1959). Thus a claim may be given its true construction and meaning by reference to the accompanying specifications and drawings which, although they cannot enlarge it, may give the claim such limitation and definition as is necessary to make its abstract words descriptive of a specific invention. *See Laitram Corp.* v. *Deepsouth Packing Co.*, 443 F.2d 928 (5th Cir. 1971). It is well settled, however, that a patent is not to be limited to the preferred embodiments shown in the specification. *See Continental Paper Bag Co.* v. *Eastern Paper Bag Co.*, 210 U.S. 405 (1908). And the general rule governing the relative weight to be accorded examples in construing a patent is set out in *Sterner Lighting, Inc.* v. *Allied Electrical Supply, Inc.*, 431 F.2d 539 (5th Cir. 1970), *cert. denied*, 401 U.S. 909 (1971). "Usually a patent will not be so strictly construed that it is held to the strict device described by the claims or shown through the drawing." 431 F.2d at 544. More specifically, "[t]he reference to a specific aspect of the invention does not limit the broader statement of the 'principal object' and the claims. . . . It is well-settled that the claims delineate the scope of protection afforded by a patent, not the specific embodiments shown in patent

drawings." *Edward Valves, Inc.* v. *Cameron Iron Works, Inc.*, 286 F.2d 933, 942 (5th Cir.), *cert. denied*, 368 U.S. 833 (1961).

The nature of the invention determines the breadth of its protection under the doctrine of equivalents. Because the doctrine rests on equitable considerations, the principle has developed that an inventor, with respect to his patent, is entitled to a range of equivalents commensurate with the scope of his invention. *American Seating Co.* v. *Southeastern Metals Co., supra*; *Rothstein* v. *Atlanta Paper Co.*, 321 F.2d 90 (5th Cir. 1963); *Up-Right, Inc.* v. *Safway Products, Inc., supra*; *Industrial Instrument Corp.* v. *Foxboro Co.*, 307 F.2d 783 (5th Cr. 1962); *U.S. Industries, Inc.* v. *Otis Engineering Corp., supra*; *Cameron Iron Works, Inc.* v. *Stekoll*, 242 F.2d 17 (5th Cir. 1957); *Southern Saw Service, Inc.* v. *Pittsburgh-Erie Saw Corp.*, 239 F.2d 339 (5th Cir. 1956), *cert. denied*, 353 U.S. 964 (1957); *Big "G" Distributing Co.* v. *Air Cleaner Service Co.*, 179 F.2d 122 (5th Cir. 1950); *Hughes* v. *Magnolia Petroleum Co.*, 88 F.2d 817 (5th Cir. 1937). Thus, "[i]f the invention is broad and primary in its character, the range of equivalents will be correspondingly broad, under the liberal construction which the courts give to such inventions." *Continental Paper Bag Co.* v. *Eastern Paper Bag Co., supra*, at 414, citing *Miller* v. *Eagle Mfg. Co.*, 151 U.S. 186, 207 (1894). *See also Hunt Tool Co.* v. *Lawrence*, 242 F.2d 347 (5th Cir.), *cert. denied*, 354 U.S. 910 (1957); *Southern Saw Service, Inc.* v. *Pittsburgh-Erie Saw Corp., supra.*

Pioneer Patents

Under the doctrine of equivalents, the broadest protection is reserved for "pioneer" or "generic" patents. A pioneer patent is "a patent covering a function never before performed, a wholly novel device, or one of such novelty and importance as to mark a distinct step in the progress of the art, as distinguished from a mere improvement or perfection of what had gone before." *Westing-*

house v. *Boyden Power Brake Co.*, 170 U.S. 537, 561-62 (1898). *See Southern Saw Service, Inc.* v. *Pittsburgh-Erie Saw Corp., supra.* Where the court is confronted with a pioneer patent, "liberality becomes the keynote of construction requiring the court to give the patentee a wide breadth of protection in construing the patent claims and specifications. . . ." *Corning Glass Works* v. *Anchor Hocking Glass Corp.*, 374 F.2d 473, 476 (3d Cir.), *cert. denied*, 389 U.S. 826 (1967). *See also Hildreth* v. *Mastoras*, 257 U.S. 27, 36 (1921) ("As [plaintiff's] patent is a generic patent, the doctrine of broad equivalents properly applies here").

File Wrapper Estoppel

An invention is construed not only in the light of its claims but also with reference to its file wrapper or prosecution history in the Patent Office. *Graham* v. *John Deere Co. of Kansas City*, 383 U.S. 1 (1966); *Crawford* v. *Heysinger*, 123 U.S. 589 (1887); *Hogg* v. *Emerson*, 52 U.S. (11 How.) 587 (1850). The file wrapper contains the complete Patent Office file of papers relating to the patent. Secret and confidential while the patent application is pending, it becomes public information once the patent is issued.

Under the file wrapper estoppel doctrine, if the file wrapper reveals that the patentee has surrendered claims, or has amended, narrowed, or otherwise limited his claims in response to the objections of the Patent Office, he may not later recapture through the doctrine of equivalents what he has given up. *Graham* v. *John Deere Co. of Kansas City, supra*; *Dry Hand Mop Co.* v. *Squeez-Ezy Mop Co.*, 17 F.2d 465 (5th Cir. 1927). As this Court stated in *Williams Bit & Tool Co.* v. *Christensen Diamond Products Co., supra*, at 633:

> "It is settled that when the holder of a patent has voluntarily amended a claim by the inclusion of narrowing language in order to avoid prior art cited by the Patent Office and thus obtain the issuance of the

patent, he is estopped from asserting that the amended claim covers what has been eliminated by the amending language."

A patentee's consent to the demands of the patent examiner made to obtain his patent, operates as a "disclaimer," and he is thereafter bound by it. *Schriber-Schroth Co.* v. *Cleveland Trust Co.*, 311 U.S. 211, 221-22 (1940); 4 Deller's Walker on Patents § 234 (2d ed. 1965).

The mere surrender or amendment of a claim in the Patent Office does not, however, forever bar a patentee from asserting the doctrine of equivalents. He is estopped only from reclaiming what he surrendered. *Borg-Warner Corp.* v. *Paragon Gear Works*, 355 F.2d 400 (1st Cir. 1965). Hence it is necessary to determine what in fact the patentee gave up in order to receive its patent, *see Edward Valves, Inc.* v. *Cameron Iron Works, Inc., supra,* and what is the essence of the invention that remains. *U.S. Peg-wood, Shank and Leather Board Co.* v. *Sturtevant Co.*, 125 F. 382, 384 (1st Cir. 1903). Moreover, an applicant should not be presumed to have made a disclaimer broader than necessary to yield to the actual challenge to his claim. *Hunt Tool Co.* v. *Lawrence, supra.*

Law Of Improvements

An improver cannot appropriate the basic patent of another, and an unlicensed improver is an infringer. *Temco Electric Motor Co.* v. *Apco Mfg. Co.*, 275 U.S. 319 (1928); *Cantrell* v. *Wallick*, 117 U.S. 689 (1886); *Cochrane* v. *Deener*, 94 U.S. 780 (1876); *Williams Bit & Tool Co.* v. *Christensen Diamond Products Co., supra*; *Reed* v. *Hughes Tool Co.*, 261 F. 192 (5th Cir. 1919); *Yancey* v. *Enright*, 230 F. 641 (5th Cir. 1916); *Bartlett* v. *Winton*, 237 F.Supp. 631 (S.D. Fla. 1964); *Continental Gin Co.* v. *Murray Co. of Texas*, 171 F.Supp. 730 (N.D. Ala.), *rev'd on other grounds sub. nom. Murray Co. of Texas, Inc.* v. *Continental Gin Co.*, 264 F.2d 65 (5th Cir.), *cert. denied*, 360 U.S. 911 (1959).

Correlatively, the grant of a patent on an improvement of a patented article does not excuse infringement of the dominant patent. *Bryan* v. *Sid W. Richardson*, 254 F.2d 191 (5th Cir. 1958); *Bowen-Itco, Inc.* v. *Houston Engineers, Inc.*, 192 F.Supp. 223 (S.D. Tex. 1961), *rev'd on other grounds*, 310 F.2d 522 (5th Cir. 1962), *cert. denied*, 372 U.S. 930 (1963). Therefore, one who appropriates the substance of a patented invention without the consent of the patentee does not escape infringement by improving upon or subtracting from the invention so long as the essential elements are retained.

Infringement, the "Best Mode," and the Countervailing Policy of Disclosure

Under 35 U.S.C.A. § 271, a patentee's rights are infringed by anyone who "makes, uses or sells" the claimed invention. Moreover, the patentee need not spell out in the patent claims each of the many possible examples of the making and using of his invention. Section 112 of the Patent Code, 35 U.S.C.A. § 112, merely requires the patentee "to set forth the best mode contemplated . . . of carrying out his invention." And normally the claims of a patent will not be restricted to such a "best mode." *Smith* v. *Snow*, 294 U.S. 1 (1935); *Edward Valves, Inc.* v. *Cameron Iron Works, Inc., supra*; *Reiner* v. *I. Leon Co.*, 285 F.2d 501 (2d Cir. 1960); *Bryan* v. *Sid W. Richardson, Inc., supra*; *B. B. Chemical Co.* v. *Ellis*, 117 F.2d 829 (1st Cr. 1941). As Judge Learned Hand stated in *B. G. Corp.* v. *Walter Kidde & Co.*, 79 F.2d 20, 22 (2d Cir. 1935):

> "It is true that [the inventor of the spark plug] did not foresee the particular adaptability of his plug to the airplane. . . . Nevertheless, he did not shoot in the dark; he laid down with perfect certainty what he wished to accomplish and how . . . [H]e is not charged with a prophetic understanding of the entire field of its usefulness."

This rule of requiring the patentee to disclose only the "best mode" is nonetheless tempered by the counter-

vailing policy of disclosure upon which the patent system is based. The root theory of the patent system is that of a trade: the inventor discloses his invention, in return for which the public grants him limited economic privileges.

> "As a reward for inventions and to encourage their disclosure, the United States offers a seventeen-year monopoly to an inventor who refrains from keeping his invention a trade secret. But the *quid pro quo* is disclosure of a process or device in sufficient detail to enable one skilled in the art to practice the invention once the period of the monopoly has expired; and the same precision of disclosure is likewise essential to warn the industry concerned of the precise scope of the monopoly asserted."

Univeral Oil Products Co. v. *Globe Oil & Refining Co.*, 322 U.S. 471, 484 (1944). Thus, a well recognized exception to the general rule of Section 112 has developed. That is, where it appears that the "best mode" is in fact *the* basic teaching and actual invention or is *the* invention claimed, then the claims of that patent will be restricted to the "best mode." *See Fritz W. Glitsch & Sons* v. *Wyatt Metal & Boiler Works*, 224 F.2d 331 (5th Cir. 1955); *Phillips Petroleum Co.* v. *Sid Richardson Carbon & Gas Co.*, 293 F.Supp. 555 (N.D. Tex. 1968), *aff'd*, 416 F.2d 10 (5th Cir. 1969). Thus, a patentee will be restricted to the use or uses indicated in the patent if that application or use is indeed the basic teaching and actual invention.

VI. The '332 Patent

We affirm the District Court's finding that Phillips' Borger polybutadiene operation did not infringe the '332 patent.

Phillips argues that it does not infringe the '332 patent because (1) the catalyst itself is different, (2) the starting material on which the catalyst operates is different, and (3) the end product is different.

1. Phillips asserts that the catalyst itself is different from that of the '332 patent because: it is prepared differently and with different components; it is mixed and reacted in the presence of the monomer, rather than out of the presence of the monomer on which it operates, as provided in the '332 patent; and the addition of iodine to the two key "Ziegler catalyst" components differentiates its catalyst from the '332 claim.

2. Phillips contends that the '332 patent is limited to the polymerization of ethylene, so the polymerization of butadiene falls beyond the scope of the '332 patent.

3. Phillips finally argues that the '332 patent is not infringed by the accused operation because a different end product is produced, not polyethylene but rather high *cis* polybutadiene, in its Borger operation.

As it construed the '332 patent, the District Court found no infringement because:

(a) Phillips does not polymerize ethylene, nor does it produce polyethylene, as disclosed by the '332 patent. Instead, Phillips polymerizes butadiene, a markedly different monomer, to produce a synthetic rubber substantially different from the plastic polyethylene.

(b) Phillips' accused catalyst is formed from three components added to butadiene. The '332 patent not only is limited to a two-component catalyst, but actually teaches away from the use of iodine as a catalyst component.

(c) Phillips' catalyst is not preformed, since all of the three catalyst components are mixed and reacted together in the presence of butadiene. Unlike the '332 catalyst, a reaction product is never formed by mixing two compounds prior to their addition to the polymerization system.

(d) Without the use of iodine or diiodobutene as a third catalytic component, Phillips' high *cis* 1, 4- polybutadiene rubber cannot be satisfactorily obtained.

(e) The conduct of the '332 patentees confirms that the only invention disclosed, and intended to be disclosed, was a catalyst for the polymerization of ethylene consisting of the reaction product of only two components, separately prepared prior to any contact with the ethylene to be polymerized.

(f) The Phillips catalyst does not perform the same function in substantially the same way to achieve substantially the same result as the catalyst claimed in the '332 patent.

(g) The Phillips catalyst using molecular iodine or diiodobutene was not a known equivalent of the '332 patent at the time of its invention.

Ziegler contests this finding of noninfringement, arguing that the Court construed the '332 patent too narrowly on each point.

Ziegler's most important contention is that the District Court erred when it found that the '332 patent is limited to a catalyst for the polymerization of ethylene. Ziegler proposes an "all uses" theory for chemical catalysts. He contends that a patent on a chemical catalyst is a "composition of matter" patent and is infringed under 35 U.S.C.A. § 271 whenever anyone, absent the patentee's permission, "makes, uses or sells" the claimed composition. This argument is too facile.

First, such an "all uses" theory presupposes that the '332 patent claims a composition of matter that is reproduced in all material respects in the accused Phillips operation. Yet there was no convincing proof that the chemical components disclosed in the '332 patent ever combined together in the Phillips process to produce that composition of matter. To the contrary, the expert testimony indicated that the presence of iodine necessitated a complicated series of reactions leading to the polymerization of butadiene, and we cannot conclude, on the record evidence, that the catalyst claimed in the '332 patent ever existed during the accused Phillips operation.

Second, we hesitate to apply so automatically an "all uses" theory to a chemical catalyst. Although the District Court here found that the '332 patent claimed a composition of matter, we are not convinced that such a limited view of a chemical catalyst is warranted. As Ziegler quite correctly points out, a chemical catalyst is a special kind of composition. In the chemical art, a catalyst is defined as a substance that affects the rate or course of a given chemical reaction or reactions without becoming a significant part of the reaction product. As Ziegler further points out, a catalyst should be analogized to a "tool." Without it, nothing (or very little) happens when particular chemicals are reacted together. But different reactions require different catalysts. Hence, a catalyst must be defined in terms of the reactions that it catalyzes. In other words, the use of a composition of matter chemical catalyst is an integral part of the definition of that particular catalyst.

With this analysis, the limited utility of viewing a chemical catalyst as simply a composition of matter becomes apparent. Clearly, a catalyst system such as that described in the '332 patent has both composition of matter and process characteristics, and to pigeonhole the '332 patent's invention as one or the other, exclusively, would be needlessly formalistic and might produce a distorted view of the true patented invention.

Nevertheless, we are not holding as a matter of law that the patentee of a chemical catalyst is protected in his monopoly only so far as he specifically claimed the reactions in which the catalyst finds use. That question is not before us. Rather, our specific task is to construe the '332 patent in a way that gives effect to the real invention, and nothing more or less. We acknowledge that a patentee should not be charged with foreseeing all of its possible uses. *See B. G. Corp.* v. *Walter Kidde Co., supra.* But where the patentee has evidently limited his claims to a particular use or has implicitly not claimed a particular use, then a proper construction of the patent must take such a limitation or exclusion into considera-

tion. In such a case, the "best mode" would not be merely an example, it would be *the* actual teaching of the patent. *See, e.g., Fritz W. Glitsch & Sons* v. *Wyatt Metal & Boiler Works, supra.*

The proper construction of a patent claiming a chemical catalyst system, therefore, looks not only at the components of the system but also at the reaction or reactions catalyzed and the reaction products. The basic question is whether the accused Phillips operation employs a catalyst system that is substantially equivalent to that disclosed in the '332 patent. Hence, we must consider, first, the components of each system, second, the particular chemical reactions catalyzed (that is, the particular monomer polymerized), and third, the reaction product (the particular polymer produced). But no one similarity or difference will be determinative.

At this point in our analysis, we feel constrained to point out that no magic formula can be discerned that will lead us inexorably to a finding of infringement or noninfringement. Many possible permutations of the above factors are possible. For example, one might employ the same components to polymerize a dfferent monomer. Or one might employ slightly different components to polymerize the same monomer. Or one might employ slightly different components to polymerize a different monomer to produce a different polymer. Or one might employ slightly different components to polymerize the same monomer to produce a different polymer. In each case, the extent of identity or similarity between the catalyst system disclosed by the '332 patent and that of the accused catalyst system will guide our determination of infringement or noninfringement.

With this approach, we examine the District Court's conclusion that the '332 patent's catalyst system is not infringed by the accused Phillips operation. After a thorough reading of the briefs, the trial testimony, and the patent itself, we agree with the District Court. First, although the components of the '332 patent's catalyst

system are employed in the accused operation, this similarity alone is not determinative of the question of infringement. Second, a proper construction of the '332 patent indicates that it claims only a catalyst system for the polymerization of ethylene. Third, the catalyst system claimed in the '332 patent was not intended by the patentees to polymerize butadiene into high *cis* 1,4-polybutadiene. Taking these three conclusions together, we hold that the basic teaching and actual invention of the '332 patent discloses exclusively a catalyst system for the polymerization of ethylene into polyethylene.

Ziegler argues, first, that the '332 patent specifically claims an application to polymerization reactions other than the polymerization of ethylene. Second, he argues that, since it is a "pioneer patent" and is therefore entitled to a very broad construction under the doctrine of equivalents, *Westinghouse* v. *Boyden Power Brake Co., supra,* the '332 patent should be construed to claim a catalyst for the polymerization of butadiene.

As to the literal infringement argument, the claims of the '332 patent nowhere mention the polymerization of butadiene. Ziegler fails completely to make out a claim of literal infringement.

As to his second contention, we conclude that, even given a broad construction, the '332 patent is limited to a catalyst for the polymerization of ethylene. Not only the patent itself, but the background of the patent, as exposed by record testimony and exhibits, makes it clear that Ziegler had no intention of claiming a catalyst for butadiene to produce the kind of polybutadiene made by Phillips in its accused Borger, Texas, operation.

Although the District Court made no explicit finding that the '332 patent was a "pioneer patent," it found that the claimed composition of matter catalyst was "new and useful" and it construed the patent broadly. We follow that approach, giving the '332 patent the broadest construction possible. In other words, we treat

the '332 patent as a "pioneer" or "general" patent. Nonetheless, we find untenably broad any construction of the patent that would encompass a catalyst for the polymerization of butadiene. No intent to claim a catalyst for the polymerization of monomers other than ethylene may be gleaned from the patent as a whole. The '332 patent is entitled "Polymerization of Ethylene;" its preamble states emphatically and succinctly that "[t]his invention relates to new and useful improvements in the polymerization of ethylene for the production of high molecular polyethylenes;" the preamble lists five "Objects of Invention," all five of which deal only with "ethylene" or "polyethylene;" the description preceding the claims focuses solely upon the polymerization of ethylene; and the Examples without exception are limited to the production of "high molecular polyethylenes" from ethylene.

In addition, to the wording of the patent itself, the evidence presented at trial indicates that the '332 patent was not intended to claim a catalyst that polymerized butadiene into high *cis* butadiene.

First, the evidence indicated that the '332 catalyst performed poorly in polymerizing butadiene. For example, in 1954 one of Ziegler's co-patentees, Dr. Martin, attempted to use the '332 catalyst to polymerize butadiene. The experiment was unsuccessful, and Martin noted in his lab journal that "butadiene was poorly polymerized."

Second, it is apparent that butadiene reacts differently than ethylene. Phillips' expert, Dr. Reynolds, testified that, unlike ethylene, butadiene is a "conjugated diolefin" that is "very different" in its "chemical reactivity." Dr. Reynolds further testified that butadiene has "very special properties" and that the "conjugated diolefin concept" plays an important role in the polymerization of butadiene. Even Ziegler's expert, Dr. Mark, testified that the polymerization of butadiene is complicated and that, depending upon the catalyst and other conditions, butadiene can polymerize to either a resinous substance or a synthetic rubber. Moreover, Ziegler himself pointed out, in a

pending patent application relating to the polymerization of propylene, that just because a catalyst polymerizes ethylene does not mean that it will necessarily operate on a higher monomer such as butadiene.

Third, Dr. Reynolds testified that polybutadiene comes in two basic forms, *cis* and *trans*. The chemical distinction between the two forms lies in the positioning of the hydrogen atoms along the chain of carbon atoms. More importantly, each form has very distinct physical characteristics. *Trans* polybutadiene is a hard, inelastic synthetic rubber, while *cis* polybutadiene is a soft, highly elastic synthetic rubber. Dr. Reynolds testified that polybutadiene containing less than eighty-five percent *cis*-type, is essentially similar in physical properties to *trans*-type, but that, once the eighty-five percent level is achieved, the physical properties associated with *cis*-type polybutadiene increase dramatically. Thus, even if the '332 catalyst had been able to polymerize butadiene to some extent, there is no convincing evidence that it would have been able to produce a polybutadiene containing at least eighty-five percent *cis*-type. In fact, in a 1961 article for a technical journal, one of Ziegler's expert witnesses wrote that "[n]o really high . . . *cis* polybutadiene has as yet been made with the aid of Ziegler-type catalysts."

Thus, on the basis of the patent itself, as construed in the light of its "pioneer" character, and on the basis of its background and development, we affirm the District Court's determination that the '332 patent is limited to the polymerization of ethylene and was not intended to encompass the formation of high *cis* polybutadiene. We affirm the finding of noninfringement as not "clearly erroneous" under Rule 52(a), F.R.Civ.P.

VI. The '115 Patent

We reverse the District Court's finding that the '115 patent was not infringed by Phillips' Adams Terminal and Monument processes. Although Phillips' arguments are similar to those made against the claimed infringement of the '332 patent, we conclude that a correct con-

struction of the patent and a proper application of the doctrine of equivalents requires a finding that the '115 patent is valid and infringed.

As with the '332 catalyst, Phillips argues that it does not infringe the '115 patent because (1) its catalyst is different, (2) the starting material on which its catalyst operates is different, and (3) its end product is different. Phillips contends that

1. the accused catalyst itself is different from that of the '115 patent because it is prepared differently and with different components: it is mixed and reacted in the presence of the monomer rather than out of the presence of the monomer on which it operates, and the addition of aluminum trichloride to the two key "Ziegler catalyst" components differentiates its catalyst from that of the '115 patent;

2. the '115 patent is limited to the polymerization of ethylene or ethylene-dominated monomers, so it does not extend to the polymerization of propylene by Phillips; and

3. the '115 patent is not infringed by the accused Phillips operations because they produce a different end product, not polyethylene or an ethylene-dominated copolymer as claimed in the patent, but rather polypropylene.

Construing the '115 patent, the District Court found no infringement because:

(a) Phillips does not polymerize ethylene nor does it produce polyethylene or an ethylene-dominated copolymer. Instead, Phillips polymerizes propylene to obtain polypropylene.

(b) The accused catalyst does not "consist essentially" of the two components required by the '115 patent claims. Rather, the Phillips catalyst is formed from diethylaluminum chloride, and a complex of titanium chloride and aluminum trichloride.

(c) Phillips' catalyst is not preformed, as required by the '115 patent. Instead, its three components are mixed and reacted together in the presence of propylene.

(d) Phillips' propylene polymerization catalyst does not perform the same function in substantially the same way to achieve the same result as the '115 catalyst. On the contrary, Phillips' three component catalyst achieves a result materially different from the result obtained with the '115 patent's catalyst.

(e) Phillips' titanium trichloride-aluminum trichloride complex is not the equivalent of titanium tetrachloride or even titanium trichloride alone.

(f) The use of a complex of titanium trichloride and aluminum trichloride was not a known equivalent of anything disclosed in the '115 patent at the time of its invention of the '115 patent.

We have already rejected Ziegler's "all uses" theory in our analysis of the '332 patent, and that same theory is equally inapplicable to the '115 patent. Thus, for Ziegler to establish infringement he must show that the accused Phillips operations either literally infringe the '115 patent or infringe a proper construction of the patent.

Starting Monomer and Ending Polymer

As to the starting monomer, we think that a proper construction of this "pioneer" patent encompasses the polymerization of propylene.

First, unlike the '332 patent, the title of the '115 patent ("Polymerization Catalyst") does not limit the claimed catalyst to the polymerization of any particular monomer.

Second, the "Objects of Invention" listed in the specification indicate that monomers other than ethylene were within the contemplated scope of the '115 patent. Particularly, the specification states that an "object of the invention is a polymerization catalyst for lower olefins up to about C_3 and particularly ethylene." This language includes the accused Phillips polypropylene operations

because propylene is a "lower olefin" within the class of olefins specified by the quoted language. Propylene is an olefin having the chemical formula $CH_2=CH\text{-}C_1$. Having three carbon atoms, it is referred to as a C_3 olefin. Thus, since the "object of invention" language discloses that the '115 patent encompasses lower olefins up to and including C_3, propylene, being a C_3, falls squarely within the range of olefins that the '115 patent's catalyst was intended to polymerize.

Third, the language of Example 15 expressly encompasses propylene, speaking of a "dried, oxygen free gaseous mixture of 12 vol. percent propylene and 88 vol. percent ethylene. . . ."

Fourth, unlike the '332 patent with respect to butadiene, the historial background of the '115 patent indicates that the polymerization of propylene with the "Ziegler catalyst" components was well established. For example, at the time the '115 application was filed, Ziegler already had an application pending (No. 514,068, filed June, 1955) for a patent on a process using the "Ziegler catalyst" components of the '332 patent to polymerize propylene. Thus, unlike the '332 patent, extrinsic circumstances do not indicate an intent to limit the '115 patent to the polymerization of ethylene.

Fifth, the '115 patent has been understood and accepted by those skilled in this particular area of organic chemistry as covering catalysts polymerizing lower olefins, specifically including propylene. Major United States corporations have paid substantial royalties to Ziegler under the '115 patent for licenses for the use of these catalysts in processes for polymerizing propylene, processes substantially identical to that of Phillips.

Phillips contends that the predominance of ethylene polymerizations in the '115 patent's Examples indicates that the contemplated scope of the patent was limited to a catalyst for ethylene polymerization. We disagree. The Examples are merely illustrative and should not be construed as limitations on the scope of the claims. *See*

Sterner Lighting, Inc. v. *Allied Electrical Supply, Inc., supra; Edward Valves, Inc.* v. *Cameron Iron Works, Inc., supra.* Moreover, nearly all of the references to ethylene in the '115 patent are preceded by the illustrative language "such as."

Thus, we conclude that the District Court erred when it construed the '115 patent as being limited to a catalyst for the polymerization of ethylene or an ethylene-dominated mixture. And since tthe patent covers a catalyst for the polymerization of propylene, it therefore encompasses an end product of polypropylene.

The Catalysts

The final factor to be considered is that of the catalysts and their components. Phillips seeks to differentiate its catalyst on four points, none of which is persuasive.

First, Phillips argues that its catalyst has three components, while the '115 patent is limited to a two component catalyst. The thrust of Phillips' argument is that the "essentially consisting of" language constitutes a file wrapper estoppel limiting Ziegler to a catalyst of two components.

The basic theory underlying the doctrine of file wrapper estoppel is that a patentee cannot recapture through the doctrine of equivalents those claims that he has surrendered, amended, narrowed, or otherwise limited in response to the objections of the Patent Office. *Graham* v. *John Deere Co. of Kansas City, supra; Williams Bit and Tool Co.* v. *Christensen Diamond Products Co., supra; Dry Hand Mop Co.* v. *Squeez-Ezy Mop Co., supra.* Here, the critical language "essentially consisting of" was inserted in the '115 patent's claims to overcome the Examiner's objection that the original claims were "too broad and based on insufficient disclosure." But Phillips failed to show anything in the file wrapper that indicated that third components were being excluded by this language. Nowhere was it necessary to amend or to restrict the claims to exclude a third component, nor did the Examiner (or

Phillips) cite any prior art to show a third component that had to be avoided by excluding it from the claim.

Ziegler argues that the "essentially consisting of" language was inserted to define more accurately and precisely the claimed catalyst as one in which the recited components, the diethyl aluminum chloride and the titanium salt, were essential elements. This revision, according to Ziegler, was necessary to avoid claiming language that would be broad enough to encompass a catalyst system in which these components might incidentally be present and yet not be essential constituents of a polymerization catalyst system.

Significantly, in its Findings of Fact, the District Court simply repeated the wording of the '115 claims and rejected Phillips' proposed language that the "essentially consisting of" phrase constituted "a compelled limitation on the claims, the effect of which was to exclude components not recited therein and which make a material difference in the catalyst formed."

We agree with Ziegler that Phillips' contention stretches both the doctrine of file wrapper estoppel and the quoted language beyond reasonableness. In the absence of any evidence that a third component was being excluded by the "essentially consisting of" language, we cannot read those words as meaning "consisting solely of" or "consisting exclusively of." Rather, the most logical and persuasive construction of the phrase would be to read it as limiting the '115 catalyst to one in which both elements are necessarily present.

Second, Phillips contends that its catalyst is different because it has different components. This argument has two prongs. Phillips' first point is that its use of titanium trichloride takes it out of the wording of the '115 claims, both because the '115 claims do not encompass titanium trichloride and because the '115 claims are limited to titanium tetrachloride. Phillips' second point is that the addition of aluminum trichloride to its catalyst system so changes the catalyst that it is no longer the equivalent of the '115 catalyst. This argument must fall on both points.

As to the first point, the '115 claims unquestionably include titanium trichloride. The precise wording of claims 1 and 2 of the '115 patent requires a "heavy metal compound from the group consisting of salts . . . of metal of groups IV-B, V-B, and VI-B of the periodic system . . ." Titanium is a group IV-B heavy metal, and both titanium tetrachloride and titanium trichloride are titanium salts. The evidence showed conclusively that this partcular form of the titanium salt, the trichloride, has found favor as the heavy metal salt component in Ziegler catalysts and is widely marketed for this purpose. A brochure of the Stauffer Chemical Company states:

> "Titanium Trichloride is an important co-catalyst used with Aluminum Alkyls, in the polymerization of olefins. Titanium Trichloride and an Aluminum Alkyl is the Ziegler-Natta catalyst system. The Specialty Chemical Division, Stauffer Chemical Company, produces catalytic grade Titanium Trichloride and other catalysts used in the polymerization of olefins."

It is apparent that titanium trichloride is a titanium salt within the meaning of that term as used in the '115 patent.

Additionally, a reading of the patent does not indicate that titanium tetrachloride was the sole titanium salt intended to be used in the '115 patent's catalyst. Although titanium tetrachloride is the only titanium salt specifically mentioned, the general references in claims 1 and 2 to "salts" indicate that the '115 patent is not to be so limited. Titanium tetrachloride is mentioned in only three of the eighteen claims, and in only eight of the Examples. Other '115 Examples employ such varied salts as zirconium tetrachloride, anhydrous ferric chloride, anhydrous ferrous chloride, anhydrous nicklous chloride, anhydrous manganous chloride, and anhydrous aluminum chloride. Moreover, the specification states that "the term 'salt' or 'salts' designating a compound having a heavy metal of the IV-B, V-B and VI-B groups of the periodic system . . . is employed in its broadest sense, *i.e.*, to connote the reaction product between a base and an acid . . ." Hence,

Phillips' citation of *Application of Ziegler,* 390 F.2d 762 (CCPA 1968), for the proposition that titanium trichloride is not necessarily in all respects the chemical equivalent of titanium tetrachloride is not on point. Because a proper construction of the '115 patent indicates that the patent embraces titantium trichloride, we need not reach this question of equivalency.

As to the second point, the effect of adding the third component aluminum trichloride, we do not view this variation as a change of such major import as to avoid the doctrine of equivalents. Rather, the "essence" of the '115 patent's catalyst pervades the Phillips operation, and the function of the doctrine of equivalents is to protect the patentee from those infringers who, without literally infringing, nonetheless appropriate the substance of the patentee's invention. *Graver, supra; Chemical Cleaning, Inc.* v. *Dow Chemical Co.,* 379 F.2d 294 (5th Cir. 1967), *cert. denied,* 389 U.S. 1040 (1968).

Defendant's evidence showed only that the Phillips catalyst was a more active catalyst, producing approximately 50 percent more polymer, and that it produced fewer undesirable by-products. At no time did anyone ever testify that the addition of the aluminum trichloride altered the fundamental polymerization action of the Ziegler components. Rather, the thrust of the testimony was directed to how much *better* the Phillips catalyst worked. Indeed, the record testimony, uncontradicted by Phillips' expert witnesses, was that no polymerization would occur unless both Ziegler components were present. In view of this evidence and testimony, we think that the District Court mistakenly viewed the Phillips catalyst as not performing the same function in substantially the same way. The testimony is clear that the Phillips catalyst performs the same function (polymerization of propylene) in the same way (with a catalyst relying essentially on the Ziegler combination) but in a better fashion (more polymer and less undesirable by-products). This catalyst, though, does not avoid infringement. Without doubt, Phillips' catalyst is an improvement, but an improver

does not escape infringing the dominant patent just by improving it. *Temco Electric Motor Co.* v. *Apco Mfg. Co., supra; Williams Bit & Tool Co.* v. *Christensen Diamond Products Co., supra.* Here, the evidence is clear that Phillips is an infringing improver.

Third, Phillips argues that its catalyst is different because it is mixed and reacted in the presence of the monomer that it polymerizes. Phillips contends that the '115 patent discloses only a catalyst that is mixed and reacted beforehand, out of the presence of the monomer on which it operates. After reviewing carefully the testimony of Phillips' expert witnesses and the claims and specification of the '115 patent, we must disagree. Remembering that the '115 patent is entitled to a broad construction as a "pioneer" patent, we must also remember the rule that a patent is not to be limited to the preferred embodiments shown in the specification. *See Continental Paper Bag Co.* v. *Eastern Paper Bag Co., supra.* The claims here contain no specific limitation requiring pre-forming, and the Examples do not exclude the alternative method of combining the Ziegler catalyst components in the presence of the monomer to be polymerized. Thus, we need not hold that pre-forming and post-forming are equivalent, because we hold that the '115 patent compels neither and permits both.

Fourth, Phillips contends that Ziegler is precluded by the file wrapper estoppel doctrine from asserting claims 2, 15 and 16 against the polypropylene operation. These claims state that the catalyst is formed by mixing the aluminum compound with the heavy metal compound "in an inert organic solvent with at least one of said aluminum compounds and said heavy metal compounds in solution in said solvent." The original claim said merely "solvent," but the Examiner objected to that term as too broad, pointing out that all of the solvents disclosed in the claims were inert solvents. This contention is meritless. The evidence before the District Court indicated that, before being put into the reactor, both the titanium salt and the

diethyl aluminum chloride are dissolved in the inert organic solvent pentane.

In summary, although Ziegler is not entitled to "all uses" of the polymerization catalyst claimed in the '115 patent, a proper construction of the patent indicates that it claims a catalyst for the polymerization of propylene, and the catalysts themselves are substantially equivalent in all essential respects. Hence, we hold that the Phillips Adams Terminal and Monument processes infringe the '115 patent. This cause must be remanded for further proceedings consistent with that holding.

VII. Validity

We affirm the District Court's finding that both the '332 and '115 patents are valid. Phillips' basic argument as to invalidity is that, given Ziegler's "all uses" construction, both patents would be invalid for lack of disclosure. *See Foster Cathead Co.* v. *Hasha, supra.* Because we reject the "all uses" theory as applied to these patents for chemical catalysts, Phillips' argument is inapposite. Moreover it does not apply to our construction of the '115 patent because we hold that the catalyst employed in the infringing Phillips polypropylene operations is substantially equivalent to the catalyst disclosed in the '115 patent.

Additionally we conclude that as construed, the '115 patent is not invalid as anticipated by the prior art.

Costs of the appeal are to be taxed equally, each party paying one half. We affirm the District Court's allocation of costs.

AFFIRMED IN PART and REVERSED and REMANDED IN PART.

Adm. Office, U.S. Courts—Scofield's Quality Printers,

IN THE UNITED STATES DISTRICT COURT
FOR THE NORTHERN DISTRICT OF TEXAS
DALLAS DIVISION

KARL ZIEGLER
Plaintiff

v.

Civil Action 3-2225

PHILLIPS PETROLEUM COMPANY
Defendant

FINDINGS OF FACT

1. This is an action for infringement of U. S. patents No. 3,257,332, hereinafter referred to as the '332 patent, and No. 3,113,115, hereinafter referred to as the '115 patent, relating to polymerization catalysts which find use in the production of synthetic polymers. The complaint charges defendant with having infringed each of these patents by making and using catalysts embodying the patented inventions. Plaintiff seeks an injunction against infringement and damages. Defendant denies the validity of the patents, denies infringement and has filed a counterclaim seeking a declaratory judgment that said patents are invalid and not infringed by Defendant.

2. The jurisdiction of this Court is predicated upon the fact that this is an action arising under Patent Laws of the United States, 28 U.S.C. Sections 1338, 2201 and 2202.

3. The plaintiff, Karl Ziegler, is an individual and a citizen and resident of Mulheim, Federal Republic of Germany.

4. The defendant, Phillips Petroleum Company, is a Delaware Corporation having a regular and established place of business in Borger, Texas in the Northern District of Texas, and is engaged among other things, in the production of synthetic rubber.

5. This action was commenced on September 6, 1967, and alleged infringement of the '332 patent. An amended complaint was filed by leave granted by this Court on August 12, 1969, and alleged in addition infringement of the '115 patent.

6. Plaintiff, Karl Ziegler, is the owner of the entire right, title and interest in said Letters Patents.

7. The patents in suit disclose catalysts which find use in the production of synthetic polymers.

8. Catalysts are substances which affect the rate or course of a given chemical reaction in some manner without becoming a significant part of the reaction products and, hence, are normally used in relatively small amounts as compared to the reactants. Materials designated as catalysts are sometimes designated in connection with the general type of reaction or reactions in which they exhibit catalytic activity.

9. Synthetic polymers are formed by causing small molecules, referred to as monomers and which are generally in the form of gases or liquids, to link together in long chains forming the polymers.

10. Examples of synthetic polymers which were known in the prior art include nylon, dacron, acrylics, synthetic rubber and polyethelene.

11. Polymerization of polyethelene during and after World War II required high pressures of over 1000 atmospheres and temperatures over 200° C. This process presented many technical difficulties and required expensive plant equipment.

12. In 1953 Ziegler and his co-workers Martin, Breil and Holzkamp at the Max-Planck Institute in Mulheim, Germany, discovered that by the interaction of an organoaluminum compound and heavy metal compound, composed of metal of Groups IV-B, V-B and VI-B of the Periodic System of Elements, a very highly active catalyst system would be formed.

13. This catalyst system was used to polymerize ethylene and did so effectively, allowing the ethylene to polymerize without the necessity of high pressures or excessive temperature.

14. Very early experiments in Germany demonstrated by simply bubbling ethylene gas through a beaker containing the catalyst in a solvent at normal pressure and normal or slightly elevated temperature, ethylene could be polymerized to a high molecular weight solid plastic.

15. The catalyst functioned in an entirely different manner than those previously available for the polymerization of monomers of the type in question, allowing the polymer chain to grow in a controlled and orderly arrangement, thus forming polymers with a substantially straight or linear chain as compared to highly branched chained polymers obtained by the previous high-pressure commercial polymerization of ethylene, with the resulting polymers having a higher density, greater rigidity and strength, and higher flow and melt temperature than those previously available.

16. The catalyst promoted the polymerization in accordance with a completely new scientific and catalytic principle by causing the polymer chain to grow on the catalyst, with the chain growth proceeding by the interposition of successive monomer units between the already formed chain and the catalyst; the successive monomer units being steered and directed into position in an orderly alignment as they became interposed in the chain at the catalyst.

17. Ziegler catalysts were immediately recognized as great scientific achievements, opening a new field of chemistry. Many U. S. corporations took options for non-exclusive license rights and almost immediately exercised their option and took a license, the license fees obtained by Ziegler amounting to many millions of dollars. Ziegler's invention has achieved almost unprecedented commercial success.

18. The Ziegler catalyst was recognized as a great scientific achievement and advance opening a new field of chemistry.

19. Karl Ziegler received the Nobel prize for his invention. In addition, he received a number of other high awards in recognition of great scientific advance and achievement.

20. The prior patents to Ipatieff, No. 2,057,432, dated October 13, 1936, and van Peski, No. 2,304,290 dated August 12, 1942, are directed to an unrelated alkylation art and have no teaching which would indicate to the artisan the combination of the components necessary to form a Ziegler catalyst as specified in patents '115 and '332.

21. Though the publication of Ipatieff and van Peski patents goes back to 1936 and 1942, respectively, these patents made no impression on the art.

22. The German Fischer patent No. 874214 does not disclose the use of an organoaluminum compound as a catalyst component.

23. Aluminum powder is not taught in the Fischer patent as a catalyst component. It simply indicates the optional use of a small amount of aluminum iron or zinc to bond acid which might be produced in the reaction.

24. An organoaluminum compound will not inherently form when following the teaching of the Fischer patent.

25. United States Patents 2,721,189; 2,905,645 and 3,114,743; Italian patent 537,425; British patent 828,791; and Belgian Patents 538,782, 543,292; 551,851; 552,644 are not prior art against plaintiff, plaintiff having an earlier effective filing date than the earliest effective date of any of this art.

THE '332 PATENT

26. The '332 patent, entitled "Polymerization of Ethylene" was issued June 21, 1966, on an application filed

November 15, 1954. As stated in the opening preamble of the patent (col. 1, ll. 12-14), the invention disclosed relates only to the "polymerization of ethylene for the production of high molecular polyethylenes."

27. The background summary of the prior art (col. 1, ll. 15-50) makes it clear that the alleged invention is directed to a manner producing a high molecular weight polyethylene at relatively low pressures.

28. All of the stated objects refer only to ethylene or polyethylene and to no other monomer or polymer. There is no teaching in the patent of the use of the disclosed catalysts for the polymerization of a monomer other than ethylene.

29. The catalyst for the polymerization of ethylene disclosed is the reaction product formed by mixing together two compounds, that is an aluminum trialkyl compound with a compound of metal of Group IV-B, V-B, and VI-B of the Periodic System of Elements (col. 1, ll. 68-70). The aluminum trialkyl compounds are enumerated at column 2, lines 24-44. There is no teaching that the catalyst might be the reaction product of three components.

30. The catalyst preparation disclosed is the preformation or premixing of the two compounds to obtain a reaction product, which is the active catalyst, prior to contacting the gaseous ethylene to be polymerized. No other method of preparing the catalyst is taught. There is no teaching that the active catalyst can be or may be formed in the presence of the monomer. The specification states that the catalyst is separately prepared prior to any contact with the ethylene. (Col. 1, lines 66-69, col. 3, lines 47-49).

31. Each of the 21 examples set forth in the specification (col. 5, line 56 to col. 10, line 21) is directed to the polymerization of ethylene in accordance with a defined two-step procedure consisting of (1) "preforming" the catalyst out of the presence of the ethylene by mixing the

two components together to form a reaction product, and (2) then reacting that product with ethylene to form polyethylene.

32. Since the issuance of the '332 patent, defendant Phillips has been operating a plant at Borger, Texas, in which it polymerizes butadiene for form synthetic rubber. In the operation of this plant a stream of butadiene and toluene and a stream of aluminum triethyl and toluene are first combined and then introduced into the mix pot. Subsequently, separate streams of titanium tetrachloride diluted in toluene and free iodine diluted in toluene are also introduced in the mix pot. These materials are mixed together in the mix pot and the mixture passed into a reactor where the butadiene polymerizes into high cis 1, 4-poly-butadiene rubber. Prior to October 1969, instead of free iodine, diiodobutene was used as a third component.

33. Defendant Phillips in its Borger operation does not polymerize ethylene and does not produce the plastic polyethylene; rather Phillips polymerizes butadiene, a markedly different monomer which is polymerized to produce a highly desirable synthetic rubber, substantially different from polyethylene.

34. Phillips' catalyst is formed from three components added to butadiene in a series of steps as set out above. The '332 patent not only is limited to a two-component catalyst, but actually teaches away from the use of iodine as a catalyst component.

35. There is no preformation of the catalyst in the Borger plant since all of the three catalyst components are mixed and react together in the presence of butadiene. Unlike the '332 catalyst, a reaction product is never formed by mixing two compounds prior to their addition to the polymerization system.

36. Without the use of iodine or diiodobutene as a third component of the catalyst, Phillips high cis 1,4-polybutadiene rubber cannot be satisfactorily obtained.

37. The conduct of the patentees confirms that the only invention disclosed, and intended to be disclosed, was a catalyst for the polymerization of ethylene consisting of the reaction product of only two components, separately prepared prior to any contact with the ethylene to be polymerized.

38. The Phillips catalyst as used in the Borger plant does not perform the same function in substantially the same way to achieve substantially the same result as the catalyst claimed in the '332 patent.

39. The Phillips catalyst using molecular iodine or diiodobutene was not the known equivalent of the '332 catalyst at the time of the invention.

THE '115 PATENT

40. The '115 patent, entitled "Polymerization Catalyst," was issued December 3, 1963, on an application filed October 29, 1958. The opening preamble states that the invention "relates to new and useful improvements in polymerization catalysts."

41. The background summary of the prior art (col. 1, ll. 16-42) concerns the fact that high polymerization pressures were necessary prior to the advent of the invention of the patent.

42. The '115 patent is directed to catalysts in which the organoaluminum compound is a dialkyl aluminum halide. Metals of Group VIII of the periodic system and manganese were added to the heavy metal compounds disclosed in the '332 patent application.

43. The charts attached to the patent '115 (Figs. 1-4) all relate to polyethylene, with the heavy metal compound being titanium tetrachloride.

44. The specification shows that the catalyst invention relates to the polymerization of gaseous ethylene (col. 2, ll. 44-47) and the copolymerization of ethylene and propylene (col. 11, ll. 35-46) with ethylene as the dominant part of the copolymer.

45. The patent discloses 16 examples (col. 11, l. 54 to col. 19, l. 50) 14 of which relate to homopolymerization of ethylene and 2 of which are directed to the production of ethylene-dominated copolymers, i.e., one formed from 88% ethylene and 12% propylene and the other from ethylene and vinylcyclohexene. All of the examples involve polymerization in accordance with a defined two-step procedure consisting of (1) "preforming" the catalyst out of the presence of the ethylene or the combination of monomers by mixing the two components together to form a reaction product, and (2) then contacting that product with the monomer to form either polyethylene or an ethylene-dominated copolymer.

46. Plaintiff contends that six of the 18 issued claims of '115, namely 1-4, 9 and 15, have been infringed by the processes practiced at Alamo's Monument plant and at Phillips' new Adams Terminal facility.

47. Claim 1 is for a "Polymerization catalyst essentially consisting of (1) an aluminum compound having the general formula RR'ALX[1] with (2) a heavy metal compound selected from the group consisting of (a) salts, (b) freshly precipitated (1) oxides and (2) hydroxides of metals of groups IV-B, V-B, and VI-B of the periodic system, including thorium and uranium, metals of group VIII of the periodic system and manganese." On the basis of the foregoing it can be seen that claim 1 defines the polymerization catalyst in terms of its two components.

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[1] The technical definition of the aluminum compound which has been elided from the claim is as follows: (a) R is a member selected from the group consisting of hydrogen, alkyl radicals and aryl radicals, (b) R' is a member selected from the group consisting of hydrogen, alkyl radicals and aryl radicals, and in which (c) X is a member selected from the group consisting of hydrogen, halogen atoms, alkoxy radicals, aryloxy radicals, mercapto radicals, and secondary amino radicals, secondary acid amide radicals, a d radicals of carboxylic acids, each of a given formula. — — —

48. Claim 2 is identical to claim 1, except in its opening and concluding portions. It defines the polymerization catalyst in terms of the reaction product of the two components by the following opening language:

> "Polymerization catalyst, essentially consisting of the product formed by mixing an aluminum compound . . . with a heavy metal compound . . ."

The concluding portion of the claim is

> ". . . in an inert organic solvent with at least one of said aluminum compounds and heavy metal compounds in solution in said solvent."

Claim 2 thus requires that the catalyst be formed in an inert organic solvent with at least one component in solution.

49. Claim 3 describes the catalyst according to claim 1, in which said aluminum compound is a dihydrocarbon aluminum halide.

50. Claim 4 describes the catalyst according to claim 1 in which the aluminum compound is a dailkyl aluminum monohalide and in which said heavy metal compound is a compound of a metal from group IV-B of the Periodic System.

51. Claim 9 describes the catalyst according to claim 1 in which said heavy metal compound is a compound of a metal from group IV-B of the Periodic System.

52. Claim 15 is a catalyst according to claim 2 in which said aluminum compound is a dihydrocarbon monohalide and in which said heavy metal compound is a heavy metal salt.

53. Also asserted by plaintiff to have been infringed, not directly but upon an equivalency theory, are claims 16-18 which define a catalyst in which the heavy metal compound is titanium tetrachloride.

54. Defendant, from 1963 until December 31, 1968, performed a polymerization process involving the polymeriza-

tion of propylene to form polypropylene plastic at a plant in La Porte, Texas, designated as the Monument plant.

55. The Monument plant was owned by Alamo, fifty percent of the stock of which was owned by the defendant during the period from July 1963 through about November 1966.

56. From December 1966 to about August 1, 1967, Phillips owned more than ninety percent of Alamo.

57. On or about August 1, 1967, the Monument plant was purchased by Diamond-Shamrock Corporation, but Phillips continued to operate the same and practiced the process for polymerizing propylene until about December 30, 1968.

58. From December 31, 1968, until July 1, 1970, the purchaser Diamond-Shamrock continued to operate the Monument plant practicing the process for polymerizing propylene.

59. On July 1, 1970, Diamond-Shamrock became a licensee of plaintiff with respect to the patents in suit and has continued from that date to operate under said license.

60. From about the beginning of 1971 to present, Phillips has operated a process for polymerizing propylene to form solid polypropylene at a plant constructed and owned by Phillips on the Houston Ship Channel in Houston, Texas, designated as the Adams Terminal plant.

61. For the purpose of this suit the propylene polymerization operation at the Monument plant and at the Adams Terminal plant may be considered identical and are referred to hereinafter as "defendant's propylene operation."

62. In defendant's propylene operation, a stream of propylene is mixed with diethyl aluminum chloride in a solvent pentane and then introduced into a loop-type reactor. A complex of titanium trichloride and aluminum trichloride dispersed in pentane solvent is mixed with propylene and introduced into the reactor. Polypropylene solid polymer is recovered from the reactor.

63. Defendant's propylene operation is not polymerizing ethylene and is not producing polyethylene or an ethylene-dominated co-polymer.

64. The catalyst used by defendant in its propylene operation does not consist essentially of the two components specified in the patent claims; on the contrary, it is formed from diethylaluminum chloride and a complex of titanium trichloride and aluminum trichloride.

65. There is no preformation of the catalyst in the accused systems since all of the three components are mixed together in the presence of propylene.

66. Defendant's propylene polymerization catalyst does not perform the same function in substantially the same way to achieve the same result as the '115 catalyst. Defendant's three-component catalyst achieves a result which is materially different from the result obtained with the catalyst of the '115 patent.

67. Defendant's titanium trichloride-aluminum trichloride complex is not the equivalent of titanium tetrachloride or even titanium trichloride alone.

68. The use of a complex of titanium trichloride and aluminum trichloride as a polymerization catalyst component was not a known equivalent of anything disclosed in the '115 patent at the time of the invention of the '115 patent.

Conclusions of Law

1. This Court has jurisdiction of the subject matter in suit and over the parties hereto.

2. Karl Ziegler is the owner of U.S. patents No. 3,357,332 and No. 3,113,115 and has the right to maintain suit for infringement of such patents.

3. Under Title 35 USCA Section 282, the patents in suit are presumed to be valid and the burden of establishing the invalidity rests upon defendant. Plaintiff has the burden of proving infringement.

4. The catalyst disclosed in the '331 and '115 patents constitute a new and useful composition of matter within the scope and meaning of 35 U.S.C. §101.

5. None of the prior art offered in evidence by Phillips identically discloses or describes the invention as claimed in the '332 and '115 patents, in accordance with the requirements set forth under 35 U.S.C. §102.

6. The difference between the subject matter set forth in the '332 and '115 patents in suit and the subject matter of the cited prior art references as a whole would not have been obvious at the time the invention was made to a person having ordinary skill in the art to which such subject matter pertains.

7. The degree of ultimate success and the scientific recognition and acclaim are considerations tending to demonstrate that the invention of the '332 and '115 patents would not have been obvious to a person having ordinary skill in the art at the time the invention was made.

8. The commercial success of the catalysts in their use in the production of synthetic polymers is a circumstance, when combined with other circumstances, which indicates invention.

9. The claims of a patent define the scope of the monopoly granted to the patentee. Every term recited in a patent claim is a limitation on the patentee's monopoly, and nothing is an infringement which does not fall within the terms in which the patentee has chosen to express his invention. The claims must be interpreted in light of the specification, and cannot be construed to cover anything different from or greater than the invention disclosed in the specification.

10. If the claims of the '332 patent were construed to cover a process to obtain high cis 1,4 polybutadiene they would necessarily be expanded beyond the limits of the actual invention. In the light of the specification the claims of '332 cannot be construed to cover a catalyst for the polymerization of monomers other than ethylene.

11. Plaintiff, by his conduct prior to the issuance of the '332 patent, is now estopped from maintaining that the claims of said patent can be read broad enough to include catalyst systems such as that used in the Borger plant.

12. The differences in the catalyst system employed by Phillips in its high cis 1,4 polybutadiene process are basic and real and the Borger operation does not infringe on the claims of the '332 patent.

13. If the claims of the '115 patent were construed to cover a process to obtain polypropylene, as practiced in Phillips polypropylene operation, they would be expanded beyond the limits of the actual invention.

14. The differences in the catalyst system employed by Phillips in its propylene operation and that of the '115 patent are material and Phillips' polypropylene operation does not infringe on the claims of the '115 patent.

15. U. S. Patent 3,113,115 is valid as to all its claims.

16. U. S. Patent 3,257,332 is valid as to all its claims.

17. Defendant has not infringed any of the claims of the U. S. Patents 3,113,115 or of U. S. Patent 3,257,332.

/s/ Sarah T. Hughes
United States District Judge

Dated: June 23, 1971

UNITED STATES CODE, TITLE 35:

§ 112. Specification

The specification shall contain a written description of the invention, and of the manner and process of making and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art to which it pertains, or with which it is most nearly connected, to make and use the same, and shall set forth the best mode contemplated by the inventor of carrying out his invention.

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention. A claim may be written in independent or dependent form, and if in dependent form, it shall be construed to include all the limitations of the claim incorporated by reference into the dependent claim.

An element in a claim for a combination may be expressed as a means or step for performing a specified function without the recital of structure, material, or acts in support thereof, and such claim shall be construed to cover the corresponding structure, material, or acts described in the specification and equivalents thereof. (Amended July 24, 1965, Public Law 89-83, sec. 9, 79 Stat. 261.)

U. S. DEPARTMENT OF COMMERCE
UNITED STATES PATENT OFFICE

August 27, 1973

This Is To Certify that the annexed is a true copy from the records of this office of a letter dated August 27, 1973, in the files of the Office of the Solicitor, and attached copies of:

(1) Decision of the Patent Office Board of Appeals *in Ex parte Davis and Tuukkanen*, 80 USPQ 448 (1948); and,

(2) Page 1 of the outline for lecture topic 7f of the Patent Office Academy.

By authority of the
Commissioner Of Patents
/s/ O. M. Suarez
Certifying Officer.

U.S. DEPARTMENT OF COMMERCE
Patent Office

August 27, 1973

To Whom It May Concern:

This is to certify that:

(1) The Patent Office Board of Appeals in *Ex parte Davis and Tuukkanen*, 80 USPQ 448 (1948), a copy of which is attached hereto, held that "• • • where the claims recite three ingredients and the reference discloses four, • • • the term 'consisting essentially of' excludes that fourth ingredient [a modifier] • • • since the 'modifier' materially changes the fundamental character of the three-ingredient composition • • •."

(2) The Patent Office Board of Appeals acknowledged in its opinion in *Ex parte Davis and Tuukkanen*, that it was "• • • influenced by the fact[s] that the construction of the term 'consisting essentially of' quoted [as follows] • • • from the code of the Primary Examiners suits the situation in this case • • •":

recital of "essentially" along with "consisting of" as rendering the claim open only for the inclusion of unspecified ingredients which do not materially affect the basic novel characteristics of the composition.

(3) The current lecture outline for the lectures given to patent examiners by the Patent Office Academy cites the aforesaid decision of the Board of Appeals in *Ex parte Davis et al.* on page 1 of the outline for lecture topic 7f, "Undue Breadth," a copy of which page is attached hereto.

/s/ Joseph F. Nakamura
Joseph F. Nakamura
Acting Solicitor

Patent Office Board of Appeals
Ex parte DAVIS AND TUUKKANEN

Patent issued Feb. 15, 1949

Opinions dated Nov. 26 and Dec. 15, 1948

1. Claims—Miscellaneous objections

Claims are improper where they specify two ingredients by trade marks.

2. Claims—"Comprising," "Consisting," etc.
"Comprising" is synonymous with "including."

3. Claims—"Comprising," "Consisting," etc.

Patentability—Invention—In general

"Consisting essentially of" in claim renders claim open only for inclusion of unspecified ingredients not materially affecting basic and novel characteristics of composition; claim reciting composition "consisting essentially of" three ingredients is patentable over reference disclosing four ingredients where fourth ingredient materially changes fundamental character of three-ingredient composition of claim.

4. Construction of specification and claims—In general

Prior adjudication—Applications for patent

Board is influenced in construction of "consisting essentially of" in claims by code adopted by examiners as to construction of "comprising," "comprising essentially," "consisting of", and "consisting essentially of" and by fact that numerous patents have issued using "consisting essentially of" in reliance upon meaning given by code.

Particular patents—Tape

2,462,037, Davis and Tuukkanen, Sealing and Reinforcing Tape, claims 13, 14, and 16 of application allowed; claims 12 and 15 refused.

Appeal from Division 38.

Application for patent of Lewis Davis and Edwin C. Tuukkanen, Serial No. 472,002, filed Jan. 11, 1943. From decision rejecting claims 12 to 17, applicant appeals. Affirmed as to claims 12 and 15; reversed as to claims 13, 14, and 16; appeal dismissed as to claim 17.

JOHN H. MCCREADY and H. L. KIRKPATRICK, both of Boston, Mass., for appellants.

Before RICHARD and GENIESSE, Examiners in Chief, and JAMES, Acting Examiner in Chief.

JAMES, Acting Examiner in Chief.

This is an appeal from the action of the examiner finally rejecting claims 12 to 17, inclusive, all of the claims in the application.

Appellants having withdrawn claim 17, the appeal as to this claim will be dismissed.

Claim 13 is illustrative and reads as follows:

13. A sealing tape comprising a strip of backing material and a normally non-tacky coating thereon of a thermo-plastic and solvent-applicable adhesive composition consisting essentially of

Ethyl cellulose	1 part
Staybelite	1 to 3 parts
Hercolyn	0.5 to 1 part

The reference relied upon is:

Abrams et al., 2,142,039, Dec. 27, 1938

The subject matter on appeal relates to a sealing tape for making and sealing shipping cartons. The tape comprises a suitable strip of backing material coated with an adhesive having the following composition by weight:

Ethyl cellulose	1 part
Staybelite (a hydrogenated rosin)	1 to 3 parts
Hercolyn (dihydro methyl abietate)	½ to 1 part

This composition is normally nontacky and waterproof. For application of the tape to cartons, the adhesive may be softened and rendered tacky by the application of heat at temperatures from about 240° F. to 280° F., or by the use of solvents such as ethyl alcohol, ethyl acetate, acetone, etc.

Claims 12 to 16, inclusive, stand rejected as lacking invention over Abrams et al. The reference discloses an adhesive sheet comprising a backing coated with a pressure sensitive, tacky composition. The following general formula is given for this composition:

Cohesive agent	15-60% by weight
Adhesive agent	10-50% by weight
Plasticizer	5-45% by weight
Modifier	4-45% by weight

The patent lists quite a number of substances as examples of each of the above ingredients, and includes ethyl cellulose as a cohesive agent, ester gum or hydrogenated rosin as an adhesive agent, dihydro methyl abietate as a plasticizer, and any one of various waxes as a modifier. Nine examples of specific formulas are given, Example 9 being the only one in which ethyl cellulose is used as the cohesive agent, and which the examiner apparently considers as most closely approaching appellant's adhesive. Example 9 includes dihydro methyl abietate as the plasticizer, ester gum as the adhesive agent, and amorphous wax as the modifier. It is to be noted that both the appellants and the patentees regard the ester gum as equivalent to Staybelite (hydrogenated rosin), the appellants stating on page 3 of the specification that ester gums can be used instead of Staybelite, and the patent listing both ester gum and hydrogenated rosin as adhesive agents.

The examiner takes the position that the selection of a narrower range of proportions than the range given in Abrams et al. and the omission of one of the ingredients of Abrams et al. do not involve invention. It is his view

that the functions of the ingredients having been indicated in the reference, inventive skill would not be required to select optimum proportions for a given application or to omit one of the ingredients where its function is not desired. The examiner also states that the expression "consisting essentially of", which occurs in all the claims, is not considered as definitely precluding the presence of ingredients other than those recited.

Appellants point out that whereas their tape is normally nontacky and forms a strong, heat-resistant bond, that of Abrams et al. is normally tacky and pressure sensitive and forms a weak, temporary bond, so that the tape can be readily peeled off and removed from any surface to which it may be attached without leaving any adhesive on the surface or fouling same. They also call attention to the fact that both the general formula and Example 9 of the reference, which set forth the percentages by weight of the ingredients of the composition, include a modifier or wax as one of the ingredients, and that the range of proportions of the other ingredients set forth in Example 9 is clearly different from that specified in such claims as 13 and 14, for example, of this application.

As to the terminology "consisting essentially of", appellants assert that this would exclude any additional ingredient, such as the modifier of Abrams et al., which would completely transform or substantially alter the essential character of the adhesive of the claims.

After carefully considering all the facts and arguments presented both by the examiner and by appellants, we have reached the conclusion that claims such as 13, 14, and 16 involve patentable subject matter. These claims set forth proportions of the ingredients which are different from that of Example 9 of the reference and which, as appellants point out, produce a radically different adhesive for a widely different and diametrically opposed purpose. The difficulty with the general formula given by Abrams et al. in lines 56 to 60, column 2, page 2, is that

the ranges of the percentages given are so wide and the number of substances represented by each ingredient is so great that, in effect, the formula is a mere invitation to experimentation to obtain the desired effect when any specific substances are selected as the ingredients. These

[1] claims, however, specify two of the ingredients by the trade marks Hercolyn and Staybelite and cannot be allowed in their present form. Ex parte Kattwinkel, 12 USPQ 11. Furthermore, the phrase "consisting essentially of" in these claims is, in our opinion, self-contradictory, and renders the claims indefinite, since the word "consisting" in a claim is construed as definitely excluding therefrom any element or ingredient not specified therein. The additional word "essentially", if it is to have any significance in the phrase, must therefore be construed as broadening the claim and permitting the use of another element or ingredient, which is directly contrary to the accepted construction of the word "consisting" in claims. What appellants intend, it is thought, is an expression

[2] such as "comprising essentially", the word "comprising" alone being synonymous with "including" but qualified in this instance by the word "essentially", and it is recommended that the phraseology be substituted for "consisting essentially of". We recommend the allowance of these claims contingent on this substitution and on the proper identification in the claims, by the use of common nouns, of the ingredients now referred to by trade marks.

Claims 12 and 15 do not specify any definite proportions of the ingredients but attempt to define the proportions broadly in terms only of function or result. We do not consider these claims to distinguish patentably from Abrams et al. See Holland Furniture Company v. Perkins Glue Company, 1928 C.D. 266, 275 U.S. 512, and General Electric Co. v. Wabash Appliance Corp., 1938 C.D. 813, 304 U.S. 364 [37 USPQ 466].

The appeal is dismissed as to claim 17.

The decision of the examiner is affirmed as to the remaining claims on appeal with recommendations made under Rule 139.

In event of appeal, attention is directed to In re Boyce, 32 C.C.P.A. 718, 144 F.2d 896, 1944 C.D. 609, 568 O.G. 568, 63 USPQ 80, in regard to specifically including in the appeal notice *all* grounds of rejection in the Examiner's Statement not expressly overruled by the Board.

MODIFICATION OF DECISION
Dec. 15, 1948

In our decision of November 26, 1948, we recommended allowance of claims 13, 14 and 16 if applicants changed "consisting essentially of" to *comprising essentially*. It was then reasoned that "consisting of" closes the claim to ingredients other than those recited (In re Gray, 1932 C. D. 85 [11 USPQ 255]) whereas the addition of the word "essentially" opens the claim and infers the presence of some other unspecified ingredient or ingredients and would therefore approach the meaning more generally recognized by the courts for "comprising" and that the two terms in the same claim were self-contradictory.

It may now be stated that search was made for some authoritative decision construing the term "consisting essentially of." While decisions were found in which it was mentioned (In re Gray, ante; In re Bertsch, 1943 C. D. 224, 231 [56 USPQ 379, 384]), none was found in which it was construed.

[3] It has come to our attention that a group of the Primary Examiners of the Patent Office, for their own guidance, adopted a code of terms for use in compositions to aid uniformity of practice which regarded:—

(1) "comprising" and "comprising essentially" as leaving the claim open for the inclusion of unspecified ingredients even in major amounts;

(2) "consisting of" as closing the claim to the inclusion of materials other than those recited except for impurities ordinarily associated therewith, and

(3) recital of "essentially" along with "consisting of" as rendering the claim open only for the inclu-

sion of unspecified ingredients which do not materially affect the basic and novel characteristics of the composition.

We regard the meaning of the terms "comprising" and "consisting of" to be well settled by numerous decisions of which In re Gray and In re Bertsch are typical. It is also clear that the expression "comprising essentially" was considered in In re Bertsch (page 231 of 1943 C. D. [56 USPQ at 384] and in the sentence beginning on the preceding page) with quotations from earlier court decisions. In particular, it was pointed out that "essentially" imposed the meaning of—indispensably necessary; important in the highest degree.

In the Bertsch case appellant was seeking to obtain the benefit of the date of an earlier copending application in order to overcome an intervening reference. His claim called for "comprising essentially." It appears that had his claim called simply for "comprising" it could have found support in the earlier case. The Court found that "comprising essentially" was to be given a different construction from simply "comprising," due to the adjudicated meaning of "essentially," but did not announce a comprehensive meaning for the whole term—"comprising essentially." The ruling was adverse to appellants' contention. It may be inferred that in construing the whole term, the Court considered what was included as well as what was excluded by it.

In the present case where the claims recite three ingredients and the reference discloses four, the important question is whether the term "consisting essentially of" excludes that fourth ingredient. We think that it does, since the "modifier" materially changes the fundamental character of the three-ingredient composition of claims 13, 14 and 16. We therefore hold that these claims are patentably distinguished in substance from Abrams et al., and withdraw the recommendation made in our former decision that "consisting essentially of" be changed

to "comprising essentially." In so doing, we are in-
[4] fluenced by the facts that the construction of the term "consisting essentially of" quoted hereinbefore from the code of Primary Examiners suits the situation in this case and also that numerous patents have issued using the term in reliance upon the meaning given it in the said code.

Topic 7f—UNDUE BREADTH

Lecture Outline

I. Introduction

   a. First paragraph of 35 U.S.C. 112.

   b. Second paragraph of 35 U.S.C. 112.

II. How breadth problems arise

   a. A need by the applicant for breadth in the claims.

   b. Function of examiner: to keep claims within the scope of the invention disclosed.

   c. Definition of "scope of the invention" and of "an equivalent".

III. Terminology used to regulate the breadth of claims

   a. Open and closed language.

      Ex parte Davis, 80 U.S.P.Q. 448.

   b. Other language such as non-numerical proportions and ranges, negative limitations, broad process steps, and words of accepted limited meaning in the art.

   c. Chemical action relationships vs. physical or mechanical relationships.

IV. Differences between chemical reactions and mechanical or physical situations with respect to degree of predictability of equivalents.